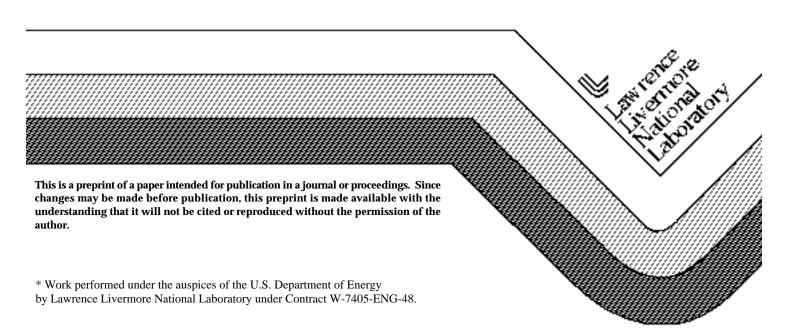
The Recent Results of ARAC's Participation in The European Tracer Experiment * (ETEX)

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RECENT RESULTS OF ARAC'S PARTICIPATION IN THE EUROPEAN TRACER EXPERIMENT

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INTRODUCTION

The European Tracer Experiment (ETEX) was an atmospheric dispersion modeling study conducted in late 1994. ETEX involved two releases of inert tracer gases, real-time predictions of the motion of the plumes by participating modeling centers, detection of the gas plumes as they passed a large network of sampler locations across most of Europe, and comparison of the model predictions with the sampler values.

The Atmospheric Release Advisory Capability (ARAC) at the Lawrence Livermore National Laboratory was one of the modeling centers which participated in ETEX. This paper will discuss the latest evaluations of ARAC's ETEX predictions, and the improvements to the ARAC system resulting from ETEX participation.

ARAC has improved by many successive changes over its 20 year history, driven in many cases by the results of model evaluations such as ETEX. Thus our prime purpose in participating was to find areas for further improvement. Another goal was to produce reasonably accurate predictions within the specified time limit.

DESCRIPTION OF WORK

The ARAC system (Sullivan et al., 1993) uses topographical and meteorological data to generate a timevarying series of three-dimensional mass-adjusted wind fields, which are used to drive the ADPIC Lagrangian particle dispersion model. ADPIC is a

three-dimensional model which accounts for the effects of spatial and temporal variation of mean wind and turbulence, gravitational settling, dry and wet deposition, and initial plume buoyancy and momentum. At the time of the ETEX releases, ADPIC used the Particle-in-Cell technique, but is now based on the Random Displacement Method (Ermak et al., 1995).

To participate in ETEX, ARAC used its operational system with only two minor modifications (Pace et al., 1995). The first was to expand the computational grid to give good resolution over the large ETEX domain. The second was to use a new source of meteorological data, the U.S. Navy's global model, NOGAPS. We have since combined both these features into our operational system.

ARAC's system allows use of multiple sources of meteorological data, but for ETEX we elected to use only NOGAPS analyses and forecasts, which we obtained on a 2.5 degree latitude/longitude grid, at the standard pressure levels, and at 12-hr intervals.

The results from the first ETEX release show ARAC was reasonably successful in predicting the motion of the part of the plume which spread eastward from the release point near Rennes in western France, across Germany into the Czech Republic, although our calculation moved this part of the plume eastward too quickly. A more serious problem is that our initial calculations did not show the part of the plume which moved northward from

France across the Benelux into the North Sea west of Denmark.

These initial calculations were made using time-varying values of boundary-layer turbulence scaling parameters (Obukhov length, mixing layer depth, etc.) in order to simulate a diurnal cycle. However, recent recalculations made using refined values for these parameters show a much better overall dispersion pattern. The improved results were achieved using smaller mixing layer depths and more stable conditions. The NOGAPS low level winds over north-central France initially after the release were westerly and rather light. Our initial calculations allowed the material to move upward too quickly and too far, into strong westerly and southwesterly flow, which drove the plume too rapidly into eastern Germany. The low level winds over eastern France 24 hr after the release time were southwesterly, and apparently it was the southerly component of this flow which drove the actual released material northward. In our initial calculations the material was already too far east when the southerly low-level flow developed over eastern France, so it was impossible for the model to simulate the subsequent northward motion.

RESULTS

We believe the NOGAPS wind forecasts were accurate because they matched subsequent analyses quite well. However, the coarse horizontal, vertical, and temporal resolution of the data, and the lack of information on boundary layer structure, may have degraded our initial results. Therefore two results of our ETEX participation were to encourage us to acquire higherresolution meteorological data, and to develop the capability to model boundary layer structure and evolution more accurately. Currently we use timevarying but grid-wide values for parameters such as mixing layer depth, stability category, etc.

Both these areas will be addressed by our future use of the U.S.

Navy's regional forecast model, NORAPS, and subsequently by their mesoscale model, COAMPS, along with improvements in our diagnostic modeling procedures. The NORAPS and COAMPS models will provide higher-resolution winds as well as data we can use to compute variable values of parameters such as mixing layer depth.

ARAC's participation in ETEX is a clear success, as we met our goals to submit timely and reasonably accurate predictions while focusing our efforts to continue ARAC's evolutionary improvement.

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